

untired frog's muscle is sufficient to raise 3 mgrm. of water from 0° to 1° C.

7. By adopting some very probable assumptions it can be inferred that the combustion of assimilated food, as far as the oxygen inspired is employed in producing chemical force, takes place almost exclusively in the muscular tissues.

P. FRANKLAND

ERNST HEINRICH WEBER

WE are called upon to chronicle the death, at Leipzig, on January 26, of Prof. Ernst Heinrich Weber, whose name is so closely united with the fundamental principles of modern optics and acoustics. He was born at Wittenberg, June 24, 1795, and after having studied at the university of that city received, in 1815, the degree of M.D. Two years later he published a short work on the anatomy of the sympathetic nerves, which brought his name at once into prominence. The following year he was appointed extraordinary professor of anatomy at the University of Leipzig, and in 1821 he became ordinary professor of human anatomy. He was early well known by his edition of Hildebrandt's "Anatomie," of which he wrote anew a considerable part in 1830. The chair of physiology was offered to him in 1840, and he actively fulfilled the duties of this position until a short time before his death. During this period he issued several manuals of physiology, and published a number of investigations, the most valuable of which are gathered together in his book "Annotationes anatomicæ et physiologicæ" (1851). Science is, however, chiefly indebted to Prof. Weber for the classical researches carried out by him and his brother Wilhelm Eduard while still young men, on which is grounded the celebrated wave-theory. The work in which their investigations are recorded—"Die Wellenlehre auf Experimente gegründet" (1825), is a remarkable relation of the most delicate and ingenious observations ever undertaken to establish a series of physical laws. Among the most notable of these might be mentioned the experiments on waves of water in mirrored troughs, by means of which they found that the particles near the surface move in circular paths, while those deeper in the liquid describe ellipses, the horizontal axes of which are longer than the vertical. By another series of comparative observations on water and mercury the law was established that waves moved with equal rapidity on the surfaces of different mediums, while the rapidity increases in both cases with the depth of the liquid. These and a multitude of other facts, studied and elaborated in the most scrupulous and conscientious manner, form the basis for the whole theoretical structure accepted at present as explanatory of the phenomena of light and sound. So thoroughly and scientifically were these researches carried out that subsequent physicists have never been called upon to correct them. In 1850 Prof. Weber completed an extensive series of experiments designed to study the wave-movement in the arterial system and explain the fact that the pulse-beat was felt at the chin a fraction of a second sooner than in the foot. The results showed that the pulse-beat travels with a rapidity of about thirty-five feet per second, and that in general the rapidity of a wave in small elastic tubes is not affected by the increase of pressure on the walls. At a later date Prof. Weber published some interesting results of experiments on the mechanism of the ear, as well as on the microscopic phenomena visible on bringing together alcohol and resin suspended in water in capillary spaces.

DR. P. BLEEKER

ON January 24 death quite suddenly overtook one of the most indefatigable workers in the field of zoological science, the well-known ichthyologist, Dr. P. Bleeker, who died at his residence in the Hague, at the age of fifty-nine. Born at Zaandam in 1819, he had an early taste for natural history, and studied medicine with a

view to an appointment in the army. In 1838 he received an appointment in the medical staff of the East Indian army, and left for Batavia. Here an immense field was soon opened to his activity. He set himself to form an immense collection of fishes from different parts of the colonies, assisted in many ways by a number of his medical colleagues at different stations. He himself always remained at Batavia, gradually rising in his profession till he obtained the inspectorate of the Colonial Medical Service. At the same time he was the centre of a keen scientific movement in the capital of the Dutch Indies, starting several societies and taking the chair in the principal of them for many consecutive years. His contributions to the Indian ichthyological fauna were regularly published in Batavian scientific journals. In 1860 he returned to his native country, and first took up his residence at Leyden, with a view to comparing the treasures contained in the zoological collections there with his own. Extensive consignments of fishes had been made by him to this institution at the time of his residence in Batavia, part of the arrangement and determination of which he now took upon himself. Not long afterwards he went to live at the Hague, where the dignity of Councillor of State Extraordinary was conferred upon him. He set to work at the gigantic task he had undertaken—the publication of his "Atlas Ichthyologique des Indes Orientales Néerlandaises," seven volumes of which, illustrated by several hundreds of coloured plates have appeared. He was herein largely assisted by grants from the Colonial Government. Many important groups, the Gobioidæ, the Scombridæ, the Scorpenidæ, &c., as well as the whole of the Elasmobranchs are left unfinished. He himself estimated that little less than half of the work remained to be published, and latterly had misgivings whether he would really be able to finish it.

The number of separate publications on East Indian fishes which have appeared from his hand in different journals exceed three hundred; they form the basis on which he gradually raised the structure of his Atlas.

He had brought home his large collection of spirit specimens which has always remained in his private possession. Of late years, as he advanced with the publication of his Atlas, he disposed of the specimens of those groups which he had finished; in this way no less than 150 of his unique type-specimens were acquired by purchase by the British Museum. Another disadvantage under which a private collection of these dimensions often labours—and Bleeker's was no exception—is the loss of the exact localities from which the different specimens of one species were procured, a detail which is afterwards of such high importance in determining the geographical range of varieties. Here, however all the specimens are mixed together in one bottle without being separately labelled.

An extensive collection of reptiles and amphibians from the Archipelago, on which he had published several papers during his stay in India, have passed to the British and Hamburg Museums.

ABOUT FISHES' TAILS

MOST people know the difference in shape that there is between the tail (caudal fin) of a salmon and that of a shark; how in the former the lobes of the fin seem to be equal or symmetrical (homocercal), and in the latter only the lower lobe of the fin is, as it were, developed, and the back bone (vertebræ) of the fish seems to be prolonged into the feebly-developed upper lobe (heterocercal). This remarkable distinction was first of all recognised by Agassiz, and long ago Owen wrote, "the preponderance of heterocercal fishes in the seas of the geological epochs of our planet is very remarkable; the prolongation of the superior lobe characterises every fossil fish of the strata anterior to and including the magnesian limestone; the

homocercal fishes first appear above that formation and gradually predominate until, as in the present period, the heterocercal bony fishes are almost limited to a single ganoid genus (*Lepidosteus*). "Indeed," writes Prof. Owen in another place, "it [the heterocercal] was the

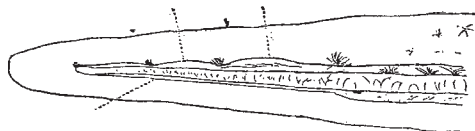


FIG. 1.

fashion of tail which prevailed in fishes throughout the palæozoic and triassic periods." It never seems to have been settled whether the fish with the homocercal tail was or was not better off than the fish with the heterocercal tail. If the more recent fishes have improved in this matter of tails upon the more ancient fishes, as was to have been

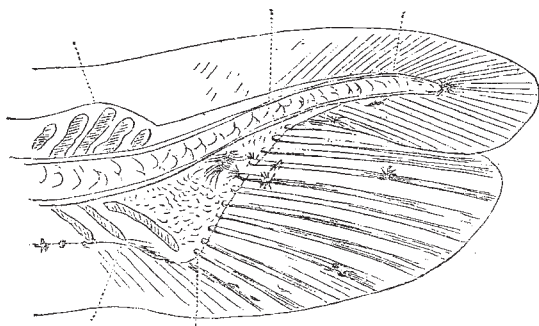


FIG. 2.

expected, certain it is that the shark of to-day can wheel quickly enough about in pursuit of his prey, and that the sword-fish can come thundering against a ship's timber with a vigour not easily matched by any fish with a symmetrical tail. Be this, however, as it may, the structure

of fishes' tails has engaged the attention of most of our comparative anatomists, and the student will find large stores of facts collected and arranged for him by Agassiz, Vogt, Owen, Kölliker, Hæckel, Huxley, and Lotz. The latter four anatomists have plainly shown that while the external appearance of the tail of modern bony fishes is, as we have seen, homocercal, their real structure is only a modified heterocercal one; so that, as far as we now know, the tail of all fishes is built upon modifications of the same type, and in a paper just published by Alexander Agassiz, "On the Young Stages of some Osseous Fishes," he proves still further that this tail fin does not differ in its mode of development from the primitive embryonic fin, or from that of the back (dorsal) fin. He describes the gradual change of the

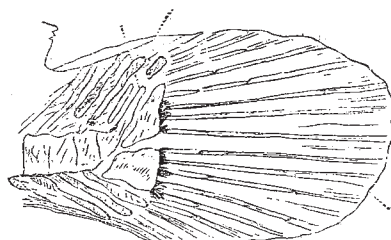


FIG. 3.

embryonic tail in several species of bony fishes, and he calls attention to the remarkable presence of an embryonic caudal lobe, which has, to this, apparently escaped the attention of naturalists, and which shows remarkably well the identity of growth between the tails of ganoid and of bony fish.

Alexander Agassiz traces the changes gradually taking place in the tail of the common flounder, from the time the little fish leaves the egg until it has nearly assumed the final shape of the adult. At first (Fig. 1) the caudal end of the chorda is straight. The caudal fin is rounded. In the next the caudal extremity of the chorda has become slightly bent upwards, and there will be found the first

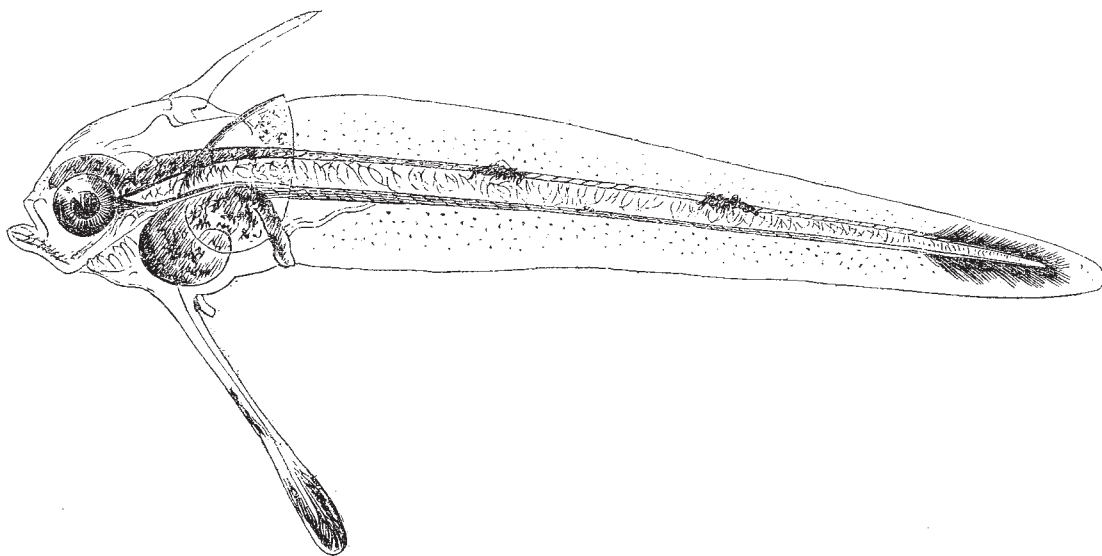


FIG. 4.

trace of the division line between the embryonic and the permanent caudal fins. In further stages this indentation between these two becomes more marked the chord becomes more arched, and the permanent caudal at length projects well beyond the outline of the embryonic

fin fold, so that antecedent to the ossification of any of the vertebral column, the tail has assumed a heterocercal form.

In the stage (Fig. 2) in which the embryonic caudal assumes the shape of a large independent lobe, while the

permanent fin appears like a second anal fin, the resemblance to the tail of a young *Lepidosteus* is most striking. The extremity of the notochord at last disappears preparatory to the formation of the urostyle, while the permanent caudal gradually develops, and soon it (Fig. 3) presents the general outline of the adult form.

A. Agassiz has traced the presence of this remarkable embryonic caudal-lobe in a large number of genera of bony fish. In the young of *Syngnathus* it is well marked. In the young of the fishing-frog (Fig. 4) (*Lophius*) the termination of the notochord remains unchanged quite late in life, but in all the genera examined the permanent tail passes quite gradually from a strictly ventral appendage placed below the dorsal column to that of a terminal tail placed in the continuation of the vertebral column.

A. Agassiz thinks that though Agassiz and Vogt were mistaken as to their details, their great generalisation will still remain true, and that there is a complete accordance between the embryonic growth of fishes' tails and the development of fishes in time, only we must now remember that the heterocercal tail is *not* the earliest stage—that the earliest stage is a nearly symmetrical one; this which he calls the leptocardial stage is that assumed by the tails of bony as well as of all other fishes, and *precedes* the heterocercal stage. As to the palæontological record, if one examines the tails of the Devonian fish as we know them from the restorations of Agassiz, Hugh Miller, Hæckel, Huxley, and others, one is quite struck by the perfect parallelism of these ancient fishes, as far as the structure of their tail is concerned, with the structure of the stages of the flounder's tail already referred to, thus carrying out the parallelism of Agassiz and Vogt far beyond anything they even conjectured. This important paper of A. Agassiz was presented to the American Academy of Arts and Sciences in October last, and for an early copy of it we are indebted to the author.

E. PERCEVAL WRIGHT

OUR ASTRONOMICAL COLUMN

LITERATURE OF THE NEBULÆ AND CLUSTERS.—No. 311 of the *Smithsonian Miscellaneous Collections* is just received. It contains an "Index Catalogue of Books and Memoirs relating to the Nebulæ and Clusters, &c.," by Prof. Holden, of Washington, commenced in 1874 for his own use, and now published in the hope, as he states, that it may be found as useful to others as it has already been to himself. It is believed to be nearly complete so far as the uses of the astronomer can require, but it has not been Prof. Holden's object to make an index for the bibliographer. The present catalogue affords facilities in the several cases that are most likely to arise, as first, in the event of all that is published on nebulæ and clusters in a particular series—the *Philosophical Transactions*, for instance—being required; again, where all papers upon the subject by any one author are sought for, and further, when all papers written upon any special subject, no matter by what author, are in question. A very useful indication of the contents of a large number of the memoirs and notices forms a feature in the work, Sir W. Herschel's papers being noticed in abstract with particular fulness. The great nebula in Orion and the variable nebulæ claim separate sections. There are also lists of figured nebulæ and an index to Sir W. Herschel's Catalogues adopting the identifications of his son's General Catalogue.

Prof. Holden has rendered an essential service to all who may be occupied with this interesting branch of astronomy, who will find his index of the greatest assistance in enabling them to learn, at the expense comparatively of little time and trouble, all that has been written upon many special subjects and upon the nebulæ and clusters generally.

NEW SOUTHERN VARIABLE STAR.—Mr. Tebbutt—who, it will be remembered, was the discoverer of the great comet of 1861 while yet telescopic—writing from Windsor, New South Wales, on November 23, notifies his having detected what would appear to be a remarkable variable star in the constellation Ara. He had seen it as a star of the fifth magnitude while observing Comet III., 1862, between October 3 and 9; it was then brighter than σ Ara, and plainly visible to the naked eye. Its place was fixed by sextant-distances from four stars. At the time of writing, Mr. Tebbutt mentions that the only star in the observed position was one of the eleventh magnitude, barely distinguishable in moonlight in his $4\frac{1}{2}$ -inch equatorial. When this star was placed in the centre of a field of about 45, no stars above the tenth magnitude were visible. But, in this case, what has become of No. 6142 of the Paramatta Catalogue, rated 7.8 m.? Mr. Tebbutt found the place of his star for 1878 0, R.A. 17h. 30m. 13s.2, N.P.D. 135° 24' 17", in which case Brisbane's star would be distant 16.8 on an angle of 193°, and should therefore have been in the field.

While writing on the subject of variable stars, we may mention that the *Annuaire du Bureau des Longitudes* for 1878 contains very full lists and ephemerides of these objects, which have been ably prepared from Prof. Schönfeld's catalogue and other sources by M. Loewy, who now has charge of the popular French work. In other respects the *Annuaire* for the present year is to be recommended as a valuable repertory of scientific facts and data.

THE ROYAL OBSERVATORY, BRUSSELS.—M. Houzeau, the successor of the late M. Quetelet in the direction of this establishment, has issued his report on the work of the year 1877. The Observatory is at present in a transition state, the instruments which have long been in use being about to be replaced by others of greater capacity. A meridian circle, almost entirely similar to that constructed for the new Observatory at Strasburg, has been ordered from Repsold; and Dent, of London, supplies the standard sidereal clock, to be accompanied by a chronograph: various modifications have been introduced into these instruments after careful consideration. A refractor of 38 centimetres aperture is in course of construction by Merz, the object-glass having already arrived at Brussels. The ancient meridian instruments have been employed on the observation of stars exhibiting decided proper motion, a work long pursued. On the mounting of the large refractor, M. Houzeau proposes to fix his attention upon three principal objects:—1st. Micrometrical measures of a certain number of double stars—binaries, and those which are affected with rapid proper motion. 2nd. To observe, with particular care, the passages of the satellites of Jupiter across his disc, and their occultations and the transits of their shadows. 3rd. Spectroscopic observations, for which a smaller refractor will also be available. Meteorological observations which have occupied much of the time of the observers during M. Quetelet's superintendence, will be continued, but in a department distinct from that devoted to astronomy, a very necessary arrangement if observations of a routine nature are not to be allowed to interfere with those of a higher class.

A FORECAST OF THE SATELLITES OF MARS.—In the last number of the *Astronomische Nachrichten*, Prof. von Oppolzer, of Vienna, draws attention to the curious passage in the "Travels into Several Remote Nations of the World by Lemuel Gulliver"—of Swift, which he transcribes from the edition of 1755. A correspondent of the *Times* referred to the same passage soon after the discovery of the satellites of Mars by Prof. Asaph Hall became known in this country. We read "they have likewise discovered two lesser stars or satellites which revolve about Mars, whereof the innermost is distant from the centre of the primary planet exactly three of his diameters, and the outermost five; the former revolves in the space of ten